owes its relief to denudation, acting on a plateau of Cretaceous limestone and andesite, on which lava-flows of basalt and rhyolite, with additional andesite, have broken out. Important post-Cretaceous intrusions of granite occur. The broad, enclosed basins of the plateau, which are well illustrated, became filled up by débris, largely wind-borne, and sandstones and conglomerates arose which almost obliterated the original relief. The present tendency is still towards the filling of such basins by the crumbling of outstanding relics of the older surface under the action of an arid type of denudation; but rivers have cut modern cañons through the mass, and are producing a new series of relief-features. It is interesting to note (p. 422) that hanging valleys have been left in the canon of the Aros "by the more rapid cutting done by the great stream."

Mr. A. Gibb Maitland chose as the subject of his presidential address to the Australasian Association for the Advancement of Science in 1907 "The Geology of Western Australia." This address forms a convenient summary of recent work, now that it has been published by Mr. Bristow, Government printer in Adelaide. Attention is directed (p. 10) to the attractions offered by the Cambrian beds of the Kimberley district, from which Hardman gathered an unlocalised Olenellus in 1883. The glacial boulder-bed east of the Kennedy Range (p. 16) is of early Carboniferous age. Laterite, in part pisolitic, occurs throughout Western Australia (p. 24), and is recognised as resulting from the decomposition and re-consolidation of the underlying rocks *in situ*. These rocks are commonly granites. Secondary silica converts some types of the laterite into quartzites; others pass over into bauxite. Here once more we are in face of the most interesting problem of weathering presented to us in the tropics. The laterite has been cut through by denuding agents, and some of it may be of early Cainozoic age, while in other places it is still forming.

Among papers dealing with special systems rather than with regional geology we may note one by Messrs. W. G. Miller and C. W. Knight on the Grenville Hastings unconformity (Sixteenth Report, Bureau of Mines, Canada, 1907, p. 221), in which it is urged that the Hastings series in Ontario and Quebec has an independent position, being unconformable to the underlying Grenville series, and not merely an altered portion of that series. The Laurentian gneiss is intrusive in the Keewatin series and in the overlying Grenville series in south-eastern Ontario. The Hastings series is styled Huronian by the authors.

Sir T. H. Holland (Records Geol. Surv. India, vol. xxxvii., 1908, p. 129) shows that the Blaini formation of Simla, in which he now finds well-striated boulders, need no longer be correlated with the Talchir beds, but may be much older, since glacial conglomerates are known from various horizons. The unfossiliferous sediments below it, hitherto regarded as Permian or older, may be actually as old as the pre-Cambrian, and may be classed with the author's Purana beds of the peninsular area.

In the same Records, vol. xxxvi. (1907), p. 23, Mr. H. H. Hayden discusses the age of the Gangamopteris beds of Kashmir, and furnishes good photographs of their occurrence in the field. These beds are "not younger than upper Carboniferous," since equivalents of the Fenestella-shales of Spiti overlie them.

A very interesting paper on desert conditions and the origin of the British Trias was contributed by the late Mr. J. Lomas to vol. x. of the Proceedings of the Liverpool Geological Society (1907), p. 172. Personal observations in Africa were utilised, and the author lost his life, as already recorded in NATURE (vol. lxxix., p. 226), while extending his researches in an area from which he hoped to gather much. Prof. Bonney, who has so long studied the Triassic pebble-beds, has commented on Mr. Lomas's conclusions in the *Geological Magazine* for 1908. Our knowledge of the marine Trias of Europe is increased by Dr. F. v. Kerner, who publishes a considerable paper on the southern border of the Svilaja planina in Dalmatia (*Verhandl. d. k.k. geol. Reichsanstalt*, 1908, pp. 259–289). In the uppermost zone there are reefs formed by calcareous algæ, with intervals of ordinary sediments between them, where detritus from earlier volcanic rocks was washed in among the limestone-building organisms.

Coming to much more recent times, Herr B. Stürtz, of Bonn, has made a detailed study of the "Rheindiluvium" from Bingerbruck, near Mainz, downwards to the Netherlands (*Verhandl. d. naturhist. Vereins der preuss. Rheinlande u. Westfalens* for 1907, published 1908, pp. 1–91). He does not seem to take into consideration the older extension of the alluvium of the Rhine to the English coast, which many authors have looked on as a feature of late Pliocene times. He regards the old delta as beginning near the Ahr, midway between Coblenz and Bonn, at a time when the stream-bed was some 150 metres higher than at present. A broad plain dropping seaward to the area of the Netherlands allowed the river to wander in various arms, much as it does now in Holland, and these arms have left their traces in high-level "diluvial" gravels. The present valleys of the main stream and of its tributaries must have been deepened by 100 to 200 metres in Pleistocene and recent times. The effects of the damming up of the waters by the Scandinavian ice-front are discussed. The higher deposits of löss are, however, attributed to wind-action, while others were laid down in a glacial lake between the uplands and the ice.

G. A. J. C.

A REMARKABLE DEVELOPMENT IN X-RAY APPARATUS.

THE old induction-coil seems likely to have a serious rival in the new apparatus which Messrs. Newton and Co., of Fleet Street, are showing. This is the "Snook" Röntgen apparatus. The machine consists of a motor converter driven from the continuous current mains, and supplying an alternating current to a step-up transformer. This transformer is immersed bodily in a galvanised iron tank filled with an insulating oil, the whole being hermetically sealed. The voltage at the secondary terminals of this transformer amounts to as much as 70,000–100,000, and can be regulated as required by means of an adjustable resistance in the primary circuit.

The most important adjunct is a mechanical rectifier, consisting of a rotating commutator of special design carried on the axle of the motor converter; thus it cannot get out of step, and, what is perhaps of as great importance, it requires no attention. The commutator when once adjusted in proper phase produces a very nearly unidirectional current, although, of course, perfection in this respect is unattainable, as will be realised when it is remembered that the current from the converter cannot be a simple harmonic one. Be this as it may, the rectification is very successfully made, and the simplicity of the device commends it when compared with the very troublesome valve tubes which must so frequently be employed for heavy X-ray work.

With regard to the efficiency, a current of 25 amperes at 200 volts in the primary circuit yields 60 milliamperes or more through an X-ray tube of 3 or 4 inches spark. Having inspected the apparatus while in action, we may state that we consider it to be a most efficient addition to the numerous arrangements available to the present-day worker in X-rays.

RECENT PAPERS ON MARINE ANIMALS.

AMONG papers on various groups of marine animals in serial and other publications which have recently reached us, reference may first be made to a fasciculus of "Illustrations of the Zoology of the Indian Survey Ship *Investigator*," containing plates devoted to new and other species of fishes, entomostracous crustaceans, and molluscs. In addition to certain deep-sea forms, the fishes include two species of skate, described by Dr. R. E. Lloyd in 1906, several kinds of stalked barnacles are figured, and the molluscs include seven species, described by Mr. E. A. Smith in the year already mentioned, of which the shells are for the first time depicted.

Reverting to fishes, we find Messrs. Gilchrist and Wardlaw Thompson contributing to the second part of vol. vi. of the Annals of the South African Museum one paper on the local Blenniidæ and another on various species from the Natal coast. The blennies have hitherto been very

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imperfectly known, in spite of their comparative abundance, and some of the species are extremely difficult to identify. Out of a total of thirty-eight South African representatives of the family, no less than twenty-two belong to the genus Clinus, of which twelve are described by the authors as new. In the second paper a very large number of species belonging to sundry genera and families are named and described; one of these—referable to Chrysophrys—is locally known as the "Englishman," and the authors have accordingly named it *Ch. anglicus*, which scarcely seems a satisfactory designation for a South African species.

To the issue of the Proceedings of the Academy of Natural Sciences of Philadelphia for December, 1908, Mr. H. W. Fowler contributes a paper on the Pennsylvanian fresh-water fishes of the family Cyprinidæ, in the course of which a new species of Notropis is described. Owing to pollution of the streams, some species of these fishes are in danger of extermination.

Much has of late years been written on the development and life-history of the eel, a further addition to the subject being a paper, illustrated with figures and a map, by Mr. Knut Dahl, which appears in the January number of *Naturen*.

From fishes we pass to whales, the Arctic fishery for which during the past season receives a brief notice by Mr. T. Southwell in the *Zoologist* for January. Six vessels were dispatched for whaling purposes in 1908, two of which visited the Greenland seas, while three proceeded to Davis Strait and one to Hudson Bay. The Greenland fishery proved the most productive, yielding ten out of the fifteen right-whales constituting the season's catch. In addition to these, the season's expedition yielded 540 white whales, 899 walruses, 3084 seals, and 241 bears. With whalebone at about 2000*l.* per ton, the total value of the produce (inclusive of a cargo brought from Pond's Bay station by the *Eclipse*) may be estimated at between 29,000*l.* and 30,000*l.*

Turning to invertebrates, the first paper for notice is one by Dr. J. Stafford, of Montreal, published in the January issue of the *American Naturalist*, on the larva and spat of the Canadian oyster. The fact that American oysters are unisexual renders possible artificial fertilisation of the eggs and rearing of the larvæ, and these young stages have been long familiar to the naturalist, but there was a big gap in our knowledge between these stages and the fixed condition. Accordingly, the author set himself the difficult task of learning to identify oyster-fry amid the hundred forms of life to be met with in the pelagic plankton. In this he was eventually successful, having observed what he took to be the larvæ settle themselves on glass plates and develop into undoubted oyster-spat. Further study of the plankton will probably enable the height of the breeding-season to be definitely determined. At present it seems that oyster-larvæ occur in the water from July 11 to September 1, and that spat make their appearance from August 16, thus suggesting that during the second half of August there occur the last stages of growth of late larvæ, and that the period of growth of the masses dates from between July 11 and August 16. The eggs are therefore probably deposited about the first of July. The paper concludes with a summary of the results of the author's investigations, and also contains remarks upon the important bearing of these and earlier observations on the problems and methods of artificial oyster-culture.

The last two papers for notice are by Dr. Gilchrist, the one, in the above-mentioned issue of the Annals of the South African Museum, on two new species of Ptychodera, and the other, in vol. xvii., part ii., of the Transactions of the South African Philosophical Society, on new forms of Hemichordata from South Africa. In the former paper Dr. Gilchrist observes that, in addition to the under-mentioned *Ptychodera capensis*, another representative of the same genus is found in the same localities in fair abundance under stones, but usually somewhat nearer to high-water mark. Among the adult forms were found a number of smaller ones, in which the proboscis and collar were in all stages of development, this apparently indicating a process of natural fragmentation or proliferation from the tail end of this species, for which the name *Pt. proliferans* was accordingly suggested. The second, *Pt. natalensis*, is from the Natal coast, and is characterised, among other features, by the extremely short proboscis. *Pt. capensis* is described in the second paper.

In the latter paper it is mentioned that the three orders of the Enteropneusta are now known to be represented in South African waters, the Enteropneusta by the above-mentioned species of Ptychodera, the Pterobranchia by a species of Cephalodiscus, and the Phoronidea by a new species of the type-genus (*Phoronis capensis*), and by the new genus and species *Phoronopsis albomaculata*. The last-named, which is figured in its fully expanded form alongside *Phoronis capensis*, is an exceedingly beautiful organism, differing from the type-genus mainly in having an involution of the epidermis with definitely differentiated (cubical) cells. The involution occurs below the nerve-ring, which it partially covers, and passes round the body so as to encircle the mouth, vent, and nephrideal apertures.

MEANING AND METHOD OF SCIENTIFIC RESEARCH.[1]

IN this day of encyclopædias numerous and ponderous, one is often struck with the fact that in spite of the manifest care and conscientious thought bestowed by the responsible editors, the omissions and evidences of discontinuity of treatment, and lack of recognition of the prime purposes of the compilation, are as noteworthy as the imposing array of the results of our steadily advancing knowledge is startling. For a philosophic treatment—one fully appreciative of that which the student really requires, not only to enlighten him with regard to a particular subject, but also to stimulate him to research where it is most needed—I frequently get more satisfaction out of the older encyclopædias than from our modern ones, even though they can but present the status of the subject up to the time they were written.

As an illustration, take the word "research," or any of the associated terms—"discovery," "experiment," "investigation," and "observation." Turning to the index volumes of the ninth and tenth editions of the "Encyclopædia Britannica," I find but two references in which the word "research" appears—one to the exploring vessel, the *Research*, and the other to "research degrees." Turning to the page on which the latter occurs, we find this interesting statement referring to Oxford University:—

"New degrees for the encouragement of research, the B.Lit. and B.Sc. (founded in 1895, and completed in 1900 by the institution of research doctorates), have attracted graduates from the universities of other countries. In 1899 a geographical department was opened, which is jointly supported by the University and by the Royal Geographical Society." Now comes the interesting statement which I beg to emphasise:—"*Of more bearing on practical life are the Day Training College Delegacy* (1892) *and the diploma in education* (1896). *Under the former elementary school teachers are enabled to take their training course at Oxford, and do so in growing numbers*," &c.

We thus see what the writer of this article thinks of the relative value in practical life of research foundations and normal school foundations! Sir Norman Lockyer, in his luminous inaugural address before the British Association for the Advancement of Science in 1903, on the "Influence of Brain-power on History," says:—"A country's research is as important in the long run as its battleships." Why, then, does not the standard encyclopædia of that country make space for a representative article on "research"?

Under "investigation" there also appears absolutely nothing. However, we have the *Investigator* ship, Investigator Shoal, Investigator Group, &c., but not a word about the general methods employed by "scientific investigators"; and so it is with the word "discovery"—there is no reference whatsoever to an article on the

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[1] Abridged from an address by Dr. L. A. Bauer as retiring president the Philosophical Society of Washington, delivered before the Society on December 5, 1908.

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